

REMARKS

Applicants, by their attorney, have amended the specification at pages 4 and 12 to correct certain errors and omissions. These amendments are believed in good faith to add no new matter.

Upon entry of the present amendment, claims 1-9 will be pending in this application. Claims 1, 2 and 5 are independent claims. For the reasons that follow, it is respectfully submitted that claims 1-9 are allowable over the applied art.

Brief Synopsis of Illustrative Embodiments

In accordance with an exemplary embodiment of the present invention, an Al-Si-Cu film is deposited on a Ti film at a temperature of at least 400 °C , to form a layer of AlTi₃ which prevents Si- recrystallization in a subsequent cooling process. By effecting the deposition of the Al-Si-Cu at a temperature of at least 400 °C the reaction between Al and Ti is promoted, and the recrystallization of Si is prevented during a subsequent cooling process. This is advantageous in preventing the formation of Si-masks, which can result in wiring pattern defects and electrical shorts in the wiring pattern. It is noted that in accordance with another exemplary embodiment, the forming of the AlTi₃ layer may be effected in an annealing step after deposition of an Al layer.

In accordance with at least one other exemplary embodiment, the AlTi₃ is deposited on the Ti film, and the Al film is deposited on the 400 °C film at a temperature of at least 400 °C. Depositing the Al film at these temperatures promotes absorption of Si into the AlTi₃. Advantageously, this suppresses the amount of Si on the Al film, thereby

preventing the formation of deleterious Si deposits that can cause pattern defects in the wiring pattern.

(Please refer to the application as filed for further details.)

Rejection under 35 USC § 102(b) in view of Wang

Claims 1 was rejected under 35 USC § 102(b) as being unpatentable over Admitted prior art in view of *Wang* (U.S. 5,604, 155).

To properly establish a *prima facie* case of anticipation, *all* of the claimed elements must be found in the prior art. It follows, therefore, that if a *single* claimed element is not found in the prior art, a *prima facie* case of anticipation cannot properly be established.

For the reasons set forth below, it is respectfully submitted that claim 1, as amended defines over the reference to *Wang*.

Wang discloses a method of depositing an Al-based layer that is made of Al/Si/Cu at a temperature of 450 °C. The reference discloses that the elevated temperature increases the surface diffusion energy of the Al atoms so that Al can fill the contact opening with no void, as well as planarizes the contact hole. While the reference recognizes that an AlTi₃ layer is formed (please refer to column 4, lines 34-40 of *Wang*), the reference does not teach that the deposition of the Al-Si-Cu film on the Ti film at a temperature of at least 400 °C to form a layer of AlTi₃ which prevents Si-recrystallization in a subsequent cooling process as is specifically claimed. Because the reference to *Wang* lacks at least a teaching of this claimed element, a *prima facie* case of anticipation cannot be established based on this reference. As such, claim 1 is believed to be allowable over the applied art. Allowance of claim 1 is earnestly solicited.

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Al₂Ti

Rejection under 35 USC §103(a) in view of Wang

Claims 2-7 were rejected under 35 USC § 103(a) as being unpatentable in view of *Wang*.

The establishment of a *prima facie* case of obviousness required that *all* of the elements be found in the prior art. Moreover, obviousness can only be established by combining or modifying the teachings of the prior art to produce the claimed invention where there is a teaching, suggestion or motivation to do so found in the references relied upon. However, hindsight is never an appropriate motivation for combining references and/or the requisite knowledge available to one having ordinary skill in the art. To this end, relying upon hindsight knowledge of applicants' disclosure when the prior art does not teach nor suggest such knowledge results in the use of the invention as a template for its own reconstruction. This is wholly improper in the determination of patentability.

With particular regard to claim 2, as amended, for reasons consistent with those described above in connection with amended claim 1, claim 2 specifically recites that the annealing at at least 400 °C is effected to *form a layer of AlTi₃, which prevents Si-recrystallization in a subsequent cooling process*. (Moreover, applicants disagree with the assertion in the Office Action that the annealing is disclosed in the reference to *Wang* discloses annealing at column 4, lines 36-37). Because the reference to *Wang* lacks at least a teaching of this claimed element, all of the elements are not found in the applied art, and therefore, a *prima facie* case of obviousness cannot be established based on this reference. As such, claim 2 is believed to be allowable over the applied art. Allowance of claim 2 is earnestly solicited.

With particular regard to claims 3-7, each of these claims includes the limitation (independently or through dependency) of *depositing* an AlTi_3 layer. Therefore, per claims 3-7 a *formed AlTi_3 layer is deposited* onto another layer (e.g., a Ti layer, or an Al-Si-Cu layer).

In stark contrast, the reference to *Wang* does not disclose the deposition of an AlTi_3 layer, but rather the *formation* of an AlTi_3 *from previously deposited* layers of Al/Si/Cu and Ti. (Please refer to the reference to *Wang* at column 3, lines 3-35). As such, the reference to *Wang* specifically lacks at least the referenced claim limitation set forth in claim 3-7. Because the reference to *Wang* lacks at least a teaching of this claimed element, all of the elements are not found in the applied art, and therefore, a prima facie case of obviousness cannot be established based on this reference. As such, claims 3-7 are believed to be allowable over the applied art. Allowance of claims 3-7 is earnestly solicited.

For the reasons set forth above, it is respectfully submitted that the rejection under 35 USC § 103(a) of claims 3-7 is improper and should be withdrawn.

Newly Added Claims

Newly added claims 8 and 9 are believed to add no new matter (Please refer to page 5, lines 10-12 of the application as filed). Newly added claim 8 and 9 depend from claims 1 and 2, respectively. For the reasons set forth above claims 1 and 2 are believed to be allowable over the applied art. As such, claims 8 and 9 are also believed to be allowable over the applied art. Allowance of claims 8 and 9 is earnestly solicited.

CONCLUSION

In view of the foregoing amendments and remarks, reconsideration and withdrawal of all objections and rejections are respectfully requested. An early notice of allowance is earnestly solicited.

Except as otherwise stated in the previous Remarks, applicants note that each of the amendments have been made to place the claims in better form for U.S. practice or to clarify the meaning of the claims; not to distinguish the claims from prior art references, otherwise narrow the scope or comply with other statutory requirements.

In the event that there are any outstanding matters remaining in the present application, the Examiner is invited to contact William S. Francos, Esq. (Reg. No. 38,456) at (610) 375-3513 to discuss these matters.

Petition is hereby made for a one-month extension of time under 37 CFR §1.136, extending the period of response from June 13 to July 15, 2002. Permission is hereby given to charge Deposit Account Number 50-0238 the required fee under 37 C.F.R. §1.17. If necessary, the Commissioner is hereby authorized in this, concurrent, and further replies to charge payment or credit any overpayment to Deposit Account Number 50-0238 for any additional fees under 37 C.F.R. §1.16 or under 37 C.F.R. §1.17.

Respectfully submitted on behalf of:

Oki Electronic Industry, Inc.

William S. Francos, Esq.

Reg. No. 38,456

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JONES VOLENTINE, L.L.C.
12200 SUNRISE VALLEY DRIVE
SUITE 150

RESTON, VA 20191

Phone: (703) 715-0870

Facsimile: (703) 715-0877

(610) - 375-
3277

Pennsylvania

- 1) called on 10/02/02 @ 3:00 PM.
- 2) 8:30 AM - gave him claim language
- 3) He will call back tomorrow -

Marked Up Version of Amended Paragraphs in the Specification

(First Embodiment) A first embodiment of the present invention will now be described in detail using to Fig. 6 to Fig. 8. First of all, an insulating film 21 (for example SiO₂, BPSG) is deposited on a semiconductor substrate 20. Next, a Ti film 22, for example, is deposited to a thickness of 50 nm, as a barrier layer. An Al film 24 is then deposited to a thickness of 400 – 800 nm by a sputter method using an Al-1.0% Si-0.5% Cu target. The temperature when this Al film is deposited is a least 400°C.

ABSTRACT OF THE DISCLOSURE [It is intended to solve a problem whereby Si nodules occur, in a wiring thin film deposition method, when depositing an Al wiring film on a semiconductor substrate with a sputter method using an Al-Si-Cu target.] An Al₃Ti film having a large amount of dissolved Si is deposited on a semiconductor substrate to form a laminate with an Al wiring film, and heat treatment is performed at a temperature of at least 400°C, to thereby absorb excessive Si into the Al₃Ti film and so prevent the occurrence of Si nodules. [Also, by] By depositing Al film at a temperature of at least 400°C at the time of depositing the Al wiring film on the Al₃Ti film, excessive Si is caused to be absorbed in the Al₃Ti film. Further, at the time of depositing a Ti film on the semiconductor substrate and depositing the Al wiring film, the Al film is deposited at a temperature of a least 400°C, there is reaction between the Ti film within the laminate, causing an Al₃Ti film to be produced, and excessive Si is absorbed in the Al₃Ti film produced.

Marked Up Version of Claims

[1.] A method of depositing a wiring thin film on a semiconductor substrate, comprising the steps of:

depositing a Ti film; and

depositing Al-Si-Cu film on the Ti film at a temperature of at least 400 °C to form a layer of Al₃Ti, which prevents Si-recrystallization in a subsequent cooling process.

[2.] A method of depositing a wiring thin film on a semiconductor substrate, comprising the steps of:

depositing a Ti film; and

depositing Al-Si-Cu film on the Ti film; and

annealing the semiconductor substrate at a temperature of at least 400 °C to form a layer of Al₃Ti, which prevents Si-recrystallization in a subsequent cooling process.